ABDOMINAL GLANDS OF HESPERIINÆ

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To the lengthy list of ectodermal glands found in insects should be added the ventral abdominal glands of certain Hesperiinæ. These are of interest not only because of the large volume and peculiar properties of their secretion but also because of the importance of this secretion during pupation. Many workers (*e.g.*, Tutt, 1905–1906, 1908–1909; Sulc, 1924; and Comstock, 1934) had observed conspicuous white patches on the underside of fully grown larvæ, but the exact origin and nature of these had not been demonstrated.

MATERIAL AND METHODS

Larvæ of all instars of *Calpodes ethlius* Cram., *Panoquina sylvicola* H.-S., *Lerodea tripunctus* H.-S., and *Polites themistocles* Latr., (Hesperiinæ) and of *Erynnis icelus* Scud. & Burg. and *Thorybes pylades* Scud., (Pyrginæ) were killed and fixed in Bouin's solution. Tissues embedded in paraffin were cut serially at 5 microns. Celloidin serial sections were cut at 25 microns. Sagittal and cross sections of the abdomen were stained with Delafield's hematoxylin and eosin, Mallory's triple connective-tissue stain, or Heidenhain's hematoxylin.

Limited amounts of the secretion were subjected to microchemical analysis and microscopic examination.

OBSERVATIONS

In view of the volume of substance secreted, the simplicity of the active gland is unusual. Four large rectangular areas composed of simple unicellular glands and located on the ventral surface of the seventh and eighth abdominal segments of larvæ belonging to the subfamily Hesperiinæ constitute the entire secretory apparatus. Each area extends from the sub-ventral fold medially to the para-ventral line (Fig. 1) and may extend the length of the segment. No external structural modifications

of the cuticle exist. Beneath the cuticle in these regions the cells of the hypodermis represent a specialized type which exhibits a gradual transition at the periphery of the glandular area from the usual squamous or cuboidal hypodermal cells to simple columnar epithelium.

Viewed from the surface the gland cells appear as irregular

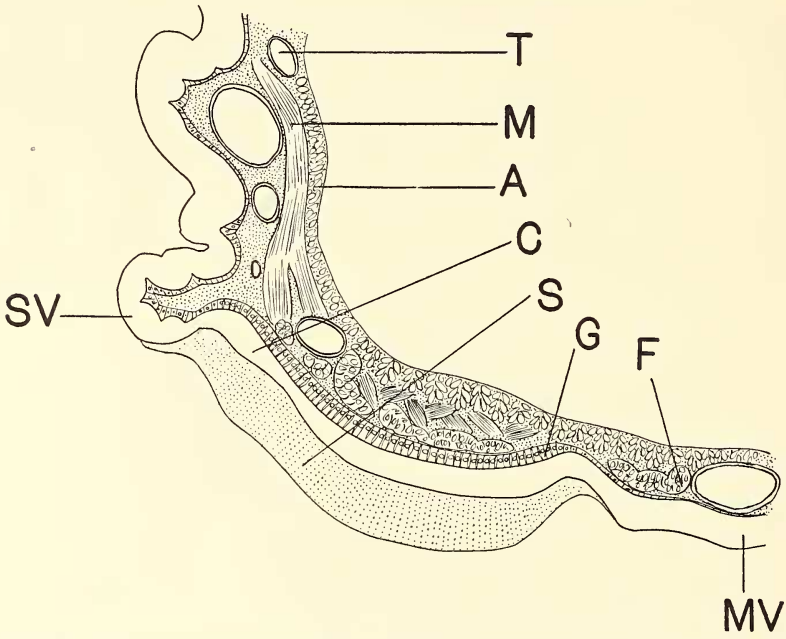

FIG. 1. Semi-diagrammatic drawing of a transverse section through the eighth abdominal segment of a larva of *Panoquina sylvicola*. Only the left half of the section is shown. T, trachea; M, muscle; A, lining of alimentary canal; C, cuticle; S, secretion; G, glandular area; F, fat body; SV, subventral fold; MV, mid-ventral line.

polygons (Plate XIV, Fig. 1). That this approximates their true shape and is not a result of distortion is evidenced by the fact that the corresponding epicuticular pattern is similarly designed. The hourglass contours of the cells seen in longitudinal section may be due in part to shrinkage. Except in the transitional areas the cells are from 3 to 5 microns tall and approximately 1.5 microns in diameter. Adjacent hypodermal cells are 1 micron on a side. At the free surface lies a well-defined striated border in contact

with the overlying endocuticle. Proximally there is a conspicuous refractive basement membrane. Distally the cytoplasm appears homogenous or finely granular though it stains more heavily with eosin than do surrounding tissues and may contain a few small vacuoles. In the basal region, however, between the nucleus and the basement membrane, the cytoplasm presents a peculiar coarse fibrous appearance. Here thick irregular fibers or cords which are highly refractive lie parallel to the long axis of the cell. In cross section they resemble myofibrils in vertebrate cardiac muscle.

The ovoid to spherical nucleus lies in the basal half of the cell. It is approximately 0.9 micron in diameter and is enclosed in a delicate nuclear membrane. Characteristic are its large spherical refringent granules. These are not seen in the nuclei of adjacent undifferentiated hypodermal cells. There is no indication of the presence of intracellular ducts or pores opening to the outside. Apparently the cells secrete directly through the overlying cuticle although it is no thinner here than above the non-secretory parts of the hypodermis.

Although the abdominal glandular areas are present in third and fourth instar larvæ, they do not become active until the fully grown larva is ready to construct a nest in which to pupate. At this time a copious white secretion appears on the overlying cuticle. Seen microscopically it is asbestos-like in structure, the threads of which it is composed lying perpendicular to the body surface.

The very small amount of material available rendered even a micro-chemical analysis difficult. While it is not possible at this time to make any statements regarding the chemical composition or structure, some of the properties may be listed.

The secretion is an amorphous material melting at 80–90 degrees C. This melting point is by no means sharp, and some decomposition takes place. Fresh material is insoluble in water, acetone, xylol, ether, chloroform, alcohols, concentrated and dilute inorganic acids, concentrated and dilute NaOH and KOH. In warm KOH it is slightly soluble while in warm H_2SO_4 it chars. No color reaction occurs in a test with HNO_3 for proteins, and ordinary histological dyes leave it unstained. It is a hydrofuge substance and can be wetted only by organic solvents.

There can be little doubt that the chief purpose of this material is to discourage the accumulation of water in the cocoon and wetting of the chrysalis. Larvæ of the Hesperiinæ construct loose cocoons in such a manner that unless precautions are taken, respiratory requirements of the chrysalis may not be met following rain or heavy dew. Pupation takes place, in most cases, on an upright blade of grass the edges of which have been drawn together. Rain and dew, especially in the tropics, tend to collect here. No more efficient method of nullifying this condition could be found than that of covering the chrysalis and lining the cocoon with a hydrophobe secretion. Adequate dispersal of the secretion is assured by the writhing of the insect prior to and following the last larval ecdysis. Spreading is further aided by the tendency of the fibers to separate and scatter on contact with water. Thus when water strikes the chrysalis, it forms small glistening drops which run off immediately.

Ventral abdominal glands for the production of hydrofuge materials are of most widespread occurrence in larvæ of the subfamily Hesperiinæ. No similar structures were found in the species of Pyrginæ examined. They or similar glands, however, occur sporadically in other related groups as for example in species of *Megathymus* (Megathymidæ). Here the secretion apparently serves the same purpose in that it water-proofs the burrow in which the larvæ of this family pupate.

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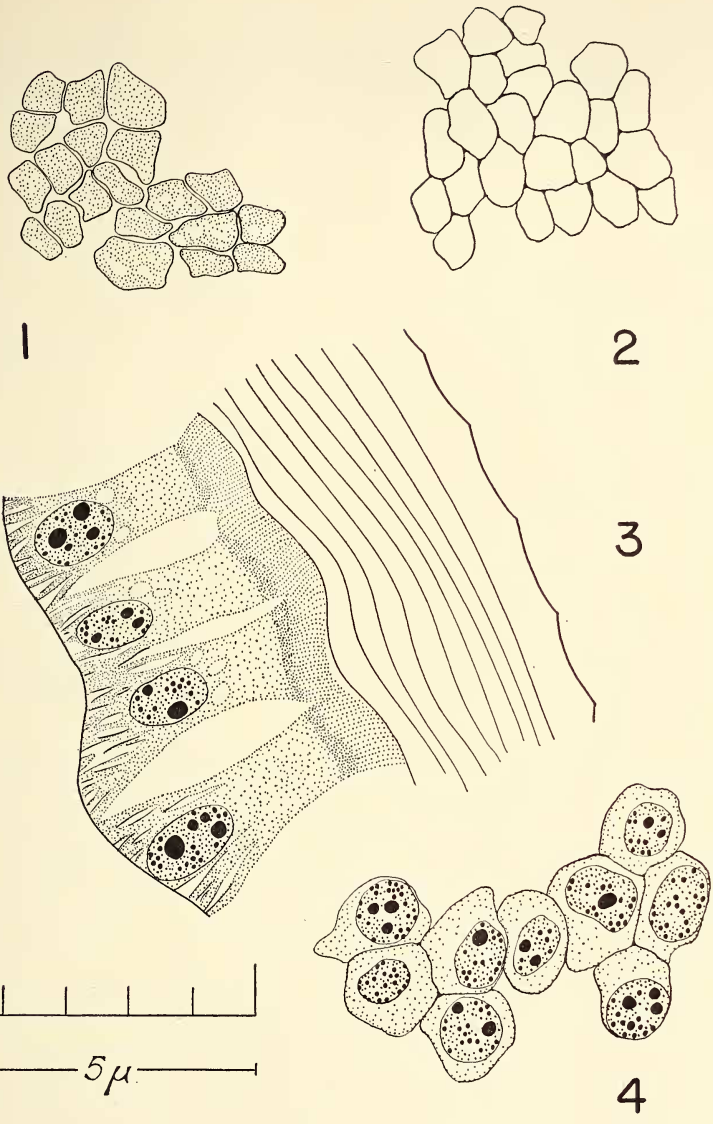
PLATE XIV

Figure 1. Transverse section through a group of gland cells just proximal to the striated border.

Figure 2. Surface pattern of overlying epicuticle.

Figure 3. Longitudinal section of several gland cells.

Figure 4. Transverse section through the nuclei of a group of gland cells.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